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**Oishi et al.**

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(54) **TILT STEERING APPARATUS**


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***B62D 1/19*** (2006.01)

(52) **U.S. Cl.**
CPC ................ ***B62D 1/195*** (2013.01); ***B62D 1/187*** (2013.01)

(58) **Field of Classification Search**
CPC .......... B62D 1/187; B62D 1/19; B62D 1/192; B62D 1/195
See application file for complete search history.



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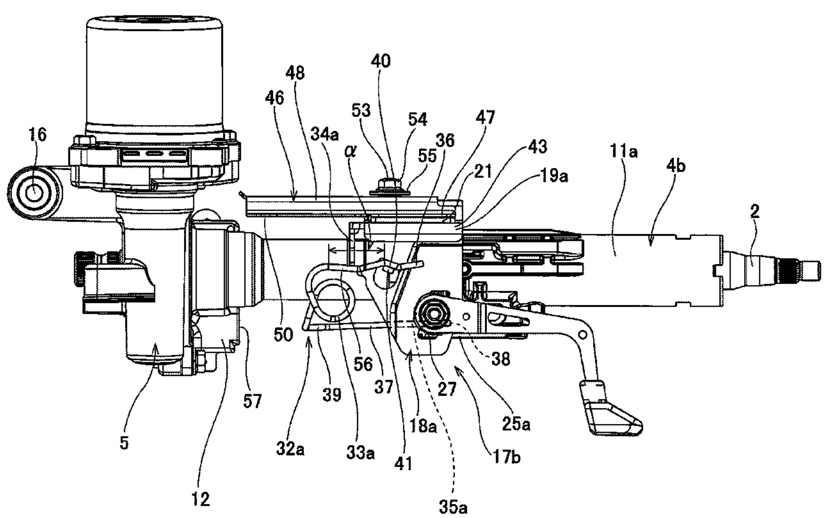
(57) **ABSTRACT**


Construction is achieved in which a steering column **4***b* and a support bracket **17***b* are able to smoothly displace in the forward direction during a secondary collision. Spring-side locking sections **40** of a bias spring **32***a* engage with locking tabs **41** of the support bracket **17***b* in a state so as to press downward on the locking tabs **41**. A pressure section **35***a* of the bias spring **32***a* engages with a receiving surface of the steering column **4***b* in a state so as to cause an upward pressure force to act on the steering column **4***b*. During a secondary collision, when the bias spring **32***a* displaces in the forward direction during the stroke through which the steering column **4***b* and support bracket **17***b* are able to displace in the forward direction and interferes with a gear housing **12** of a steering-assist apparatus **5**, the locked state between the spring-side locking sections **40** and the locking tabs **41** is released, which allows the steering column **4***b* and the support bracket **17***b* to smoothly displace further in the forward direction.


**9 Claims, 11 Drawing Sheets**



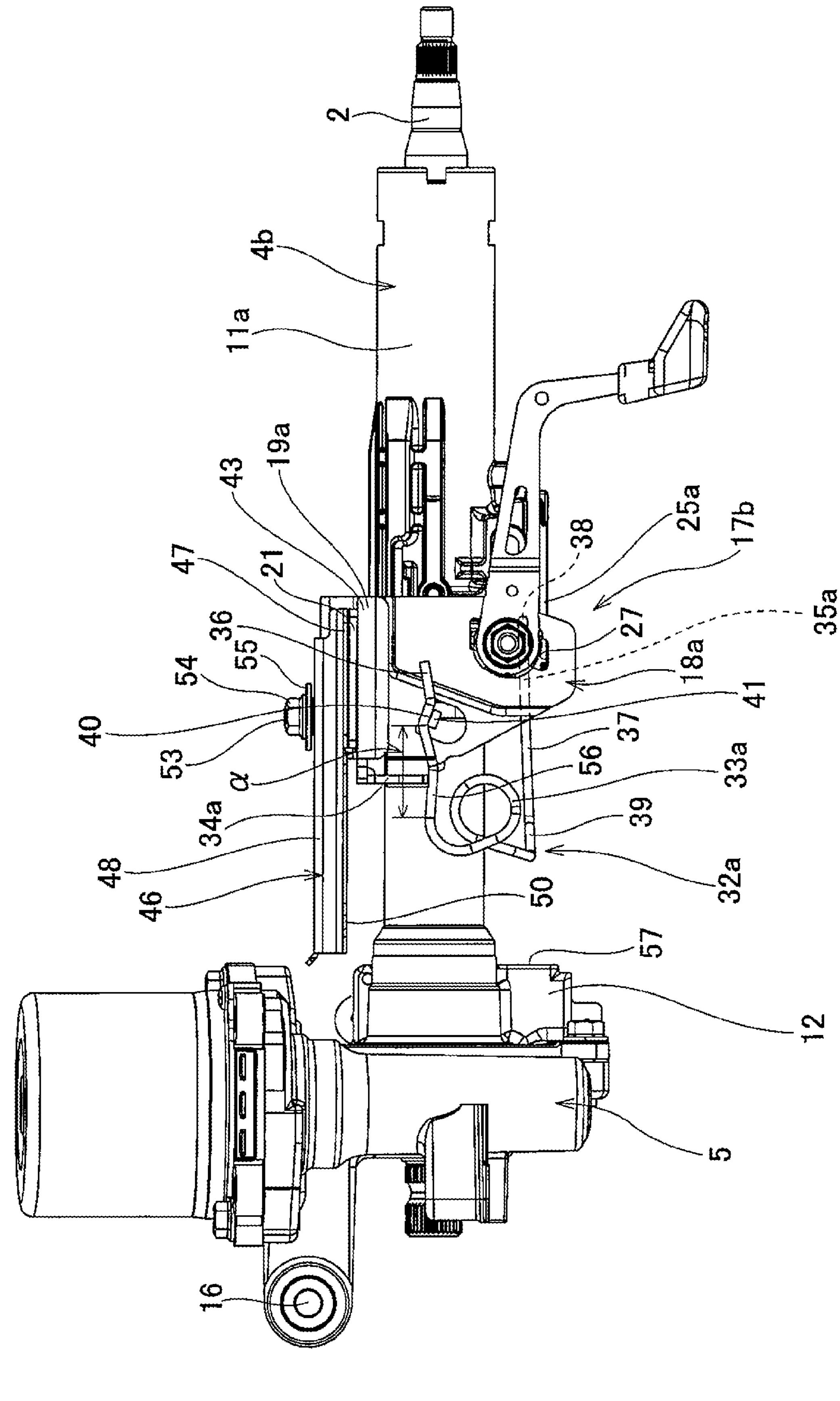

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Fig. 1

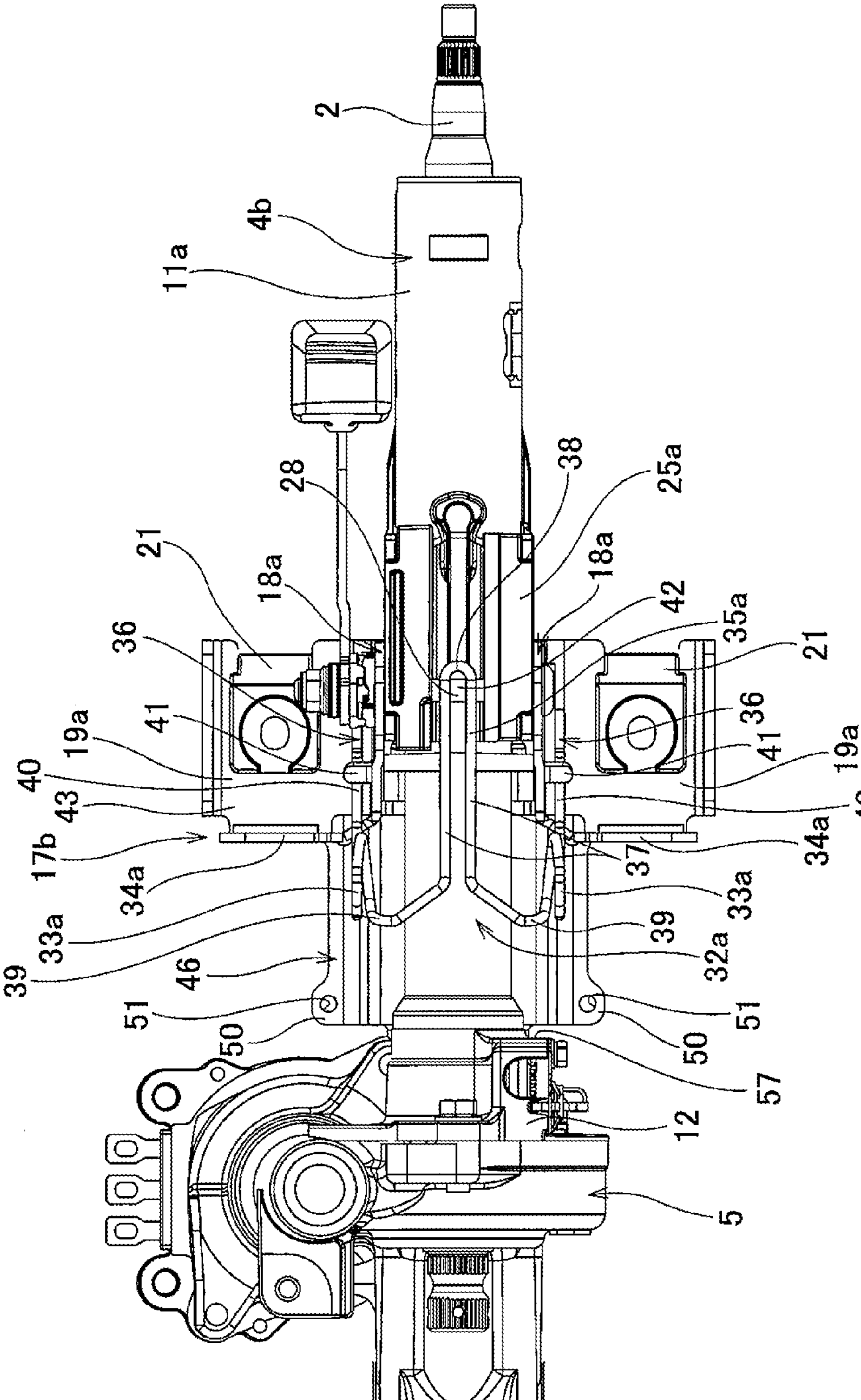
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Fig.2

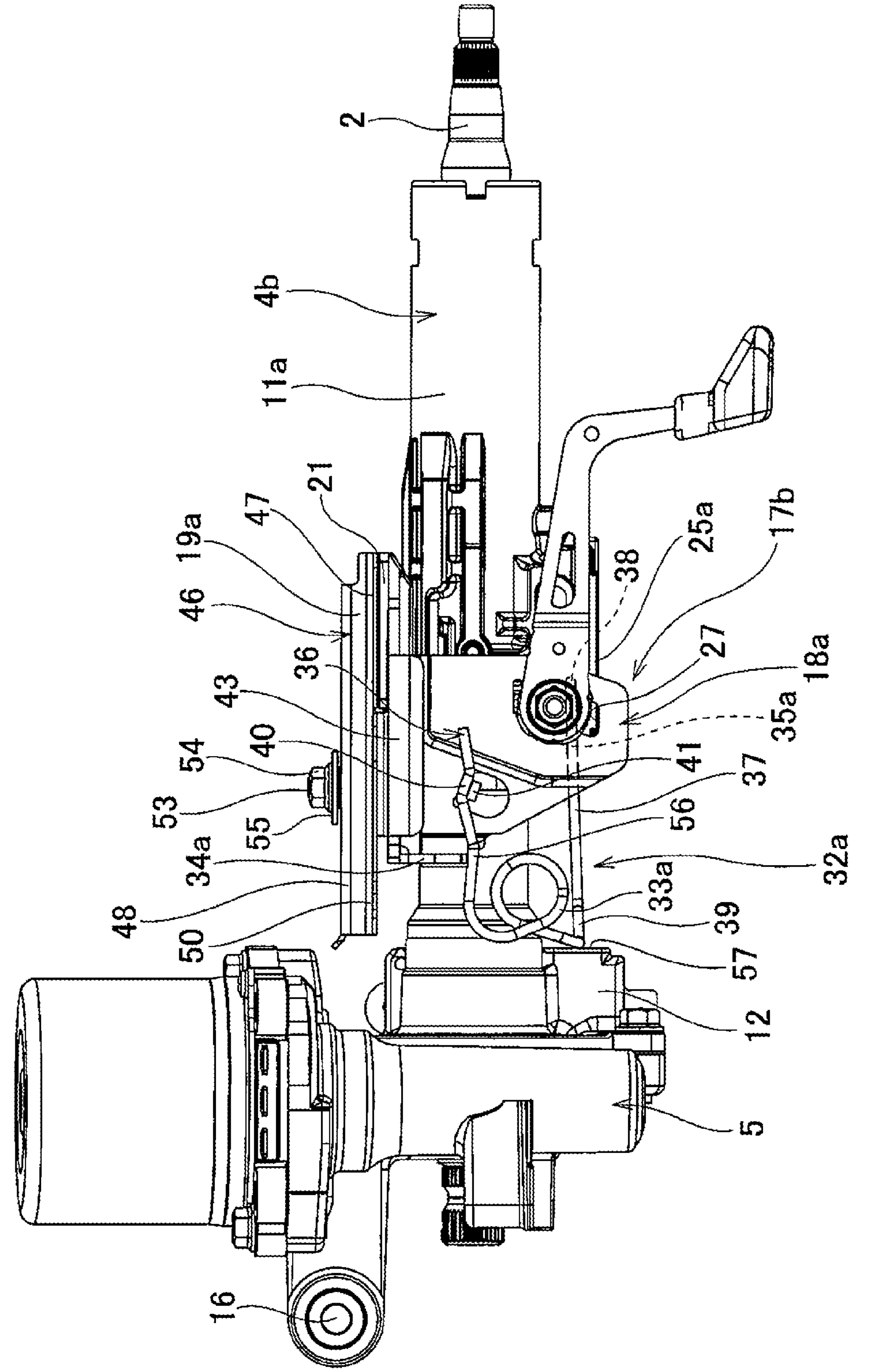
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Fig.3

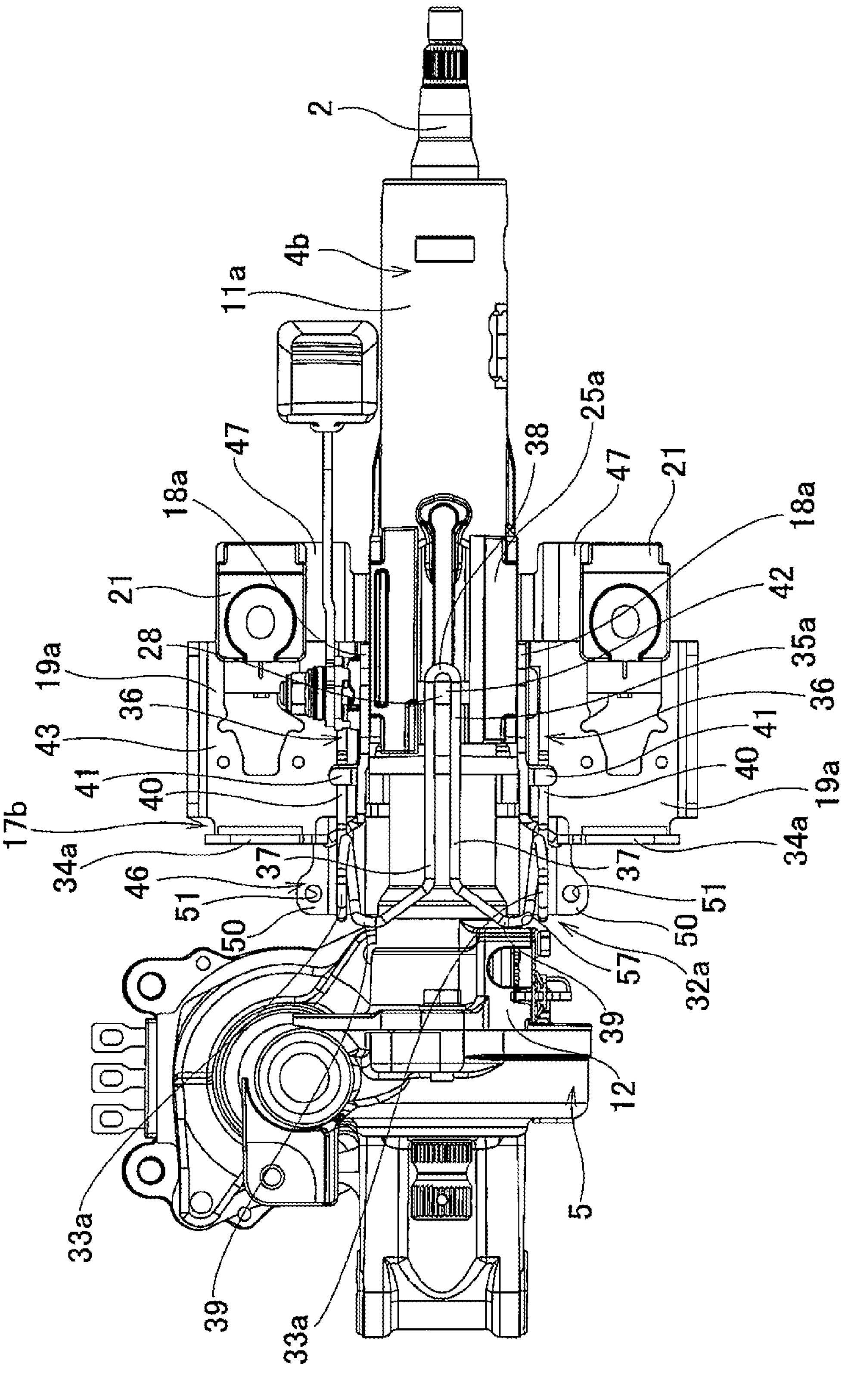
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Fig.4

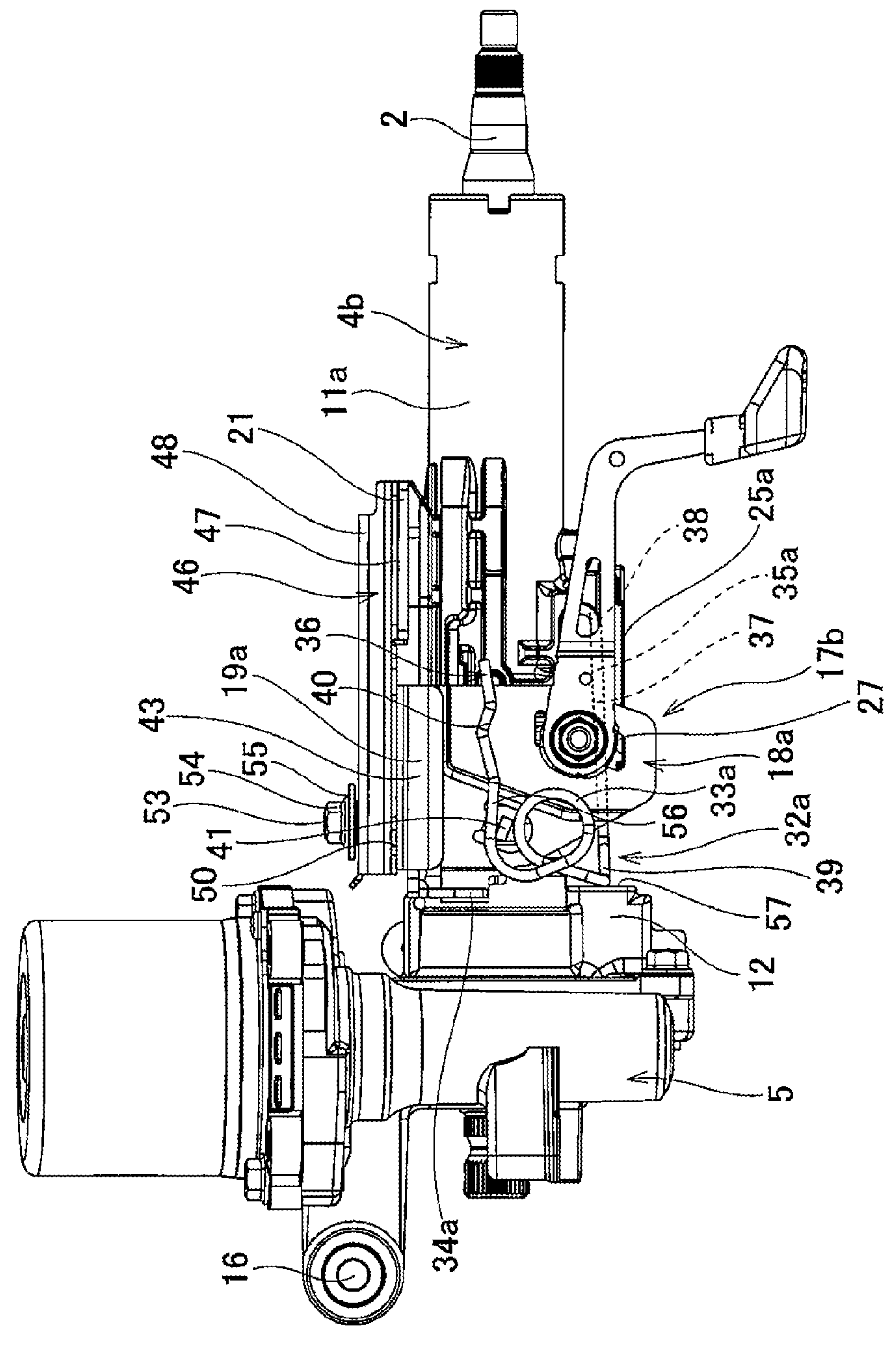
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Fig.5

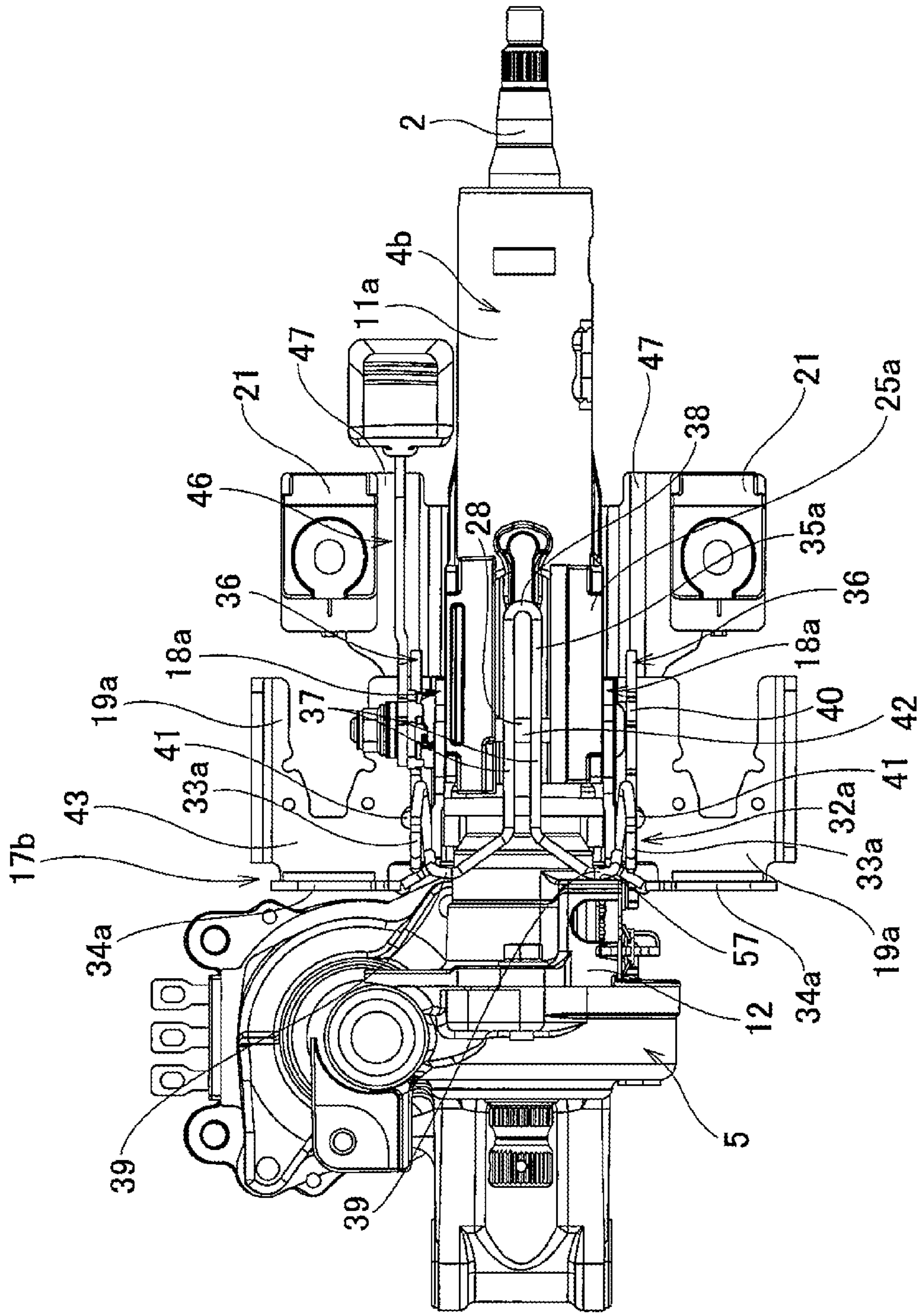
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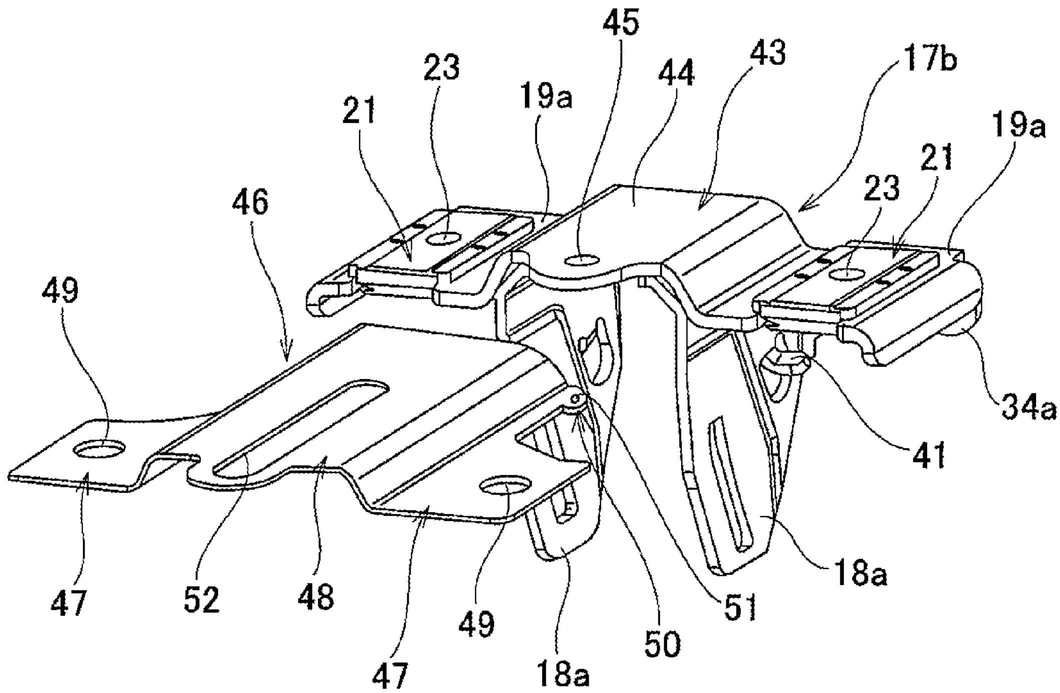
Fig.6

Fig.7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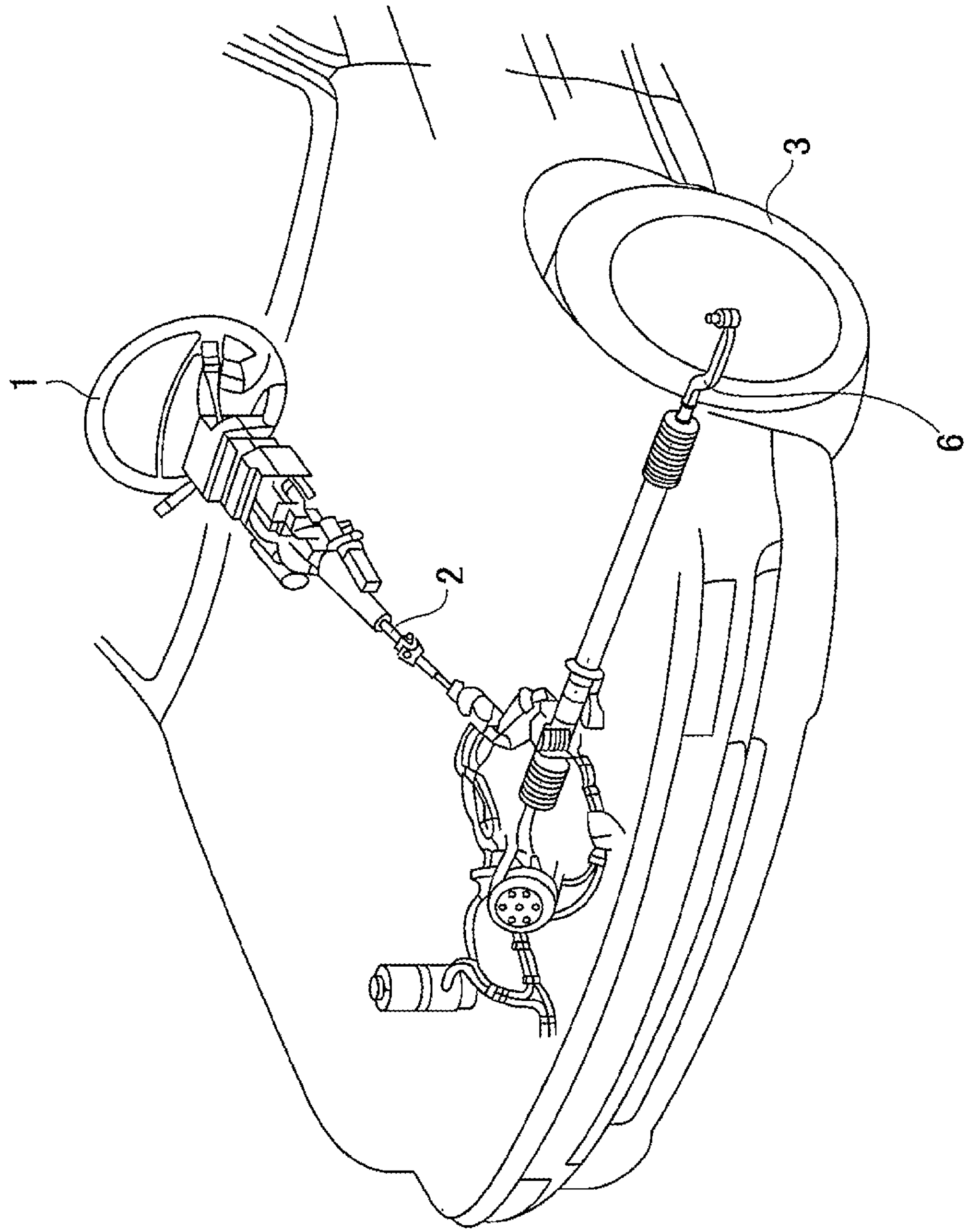



Fig.8

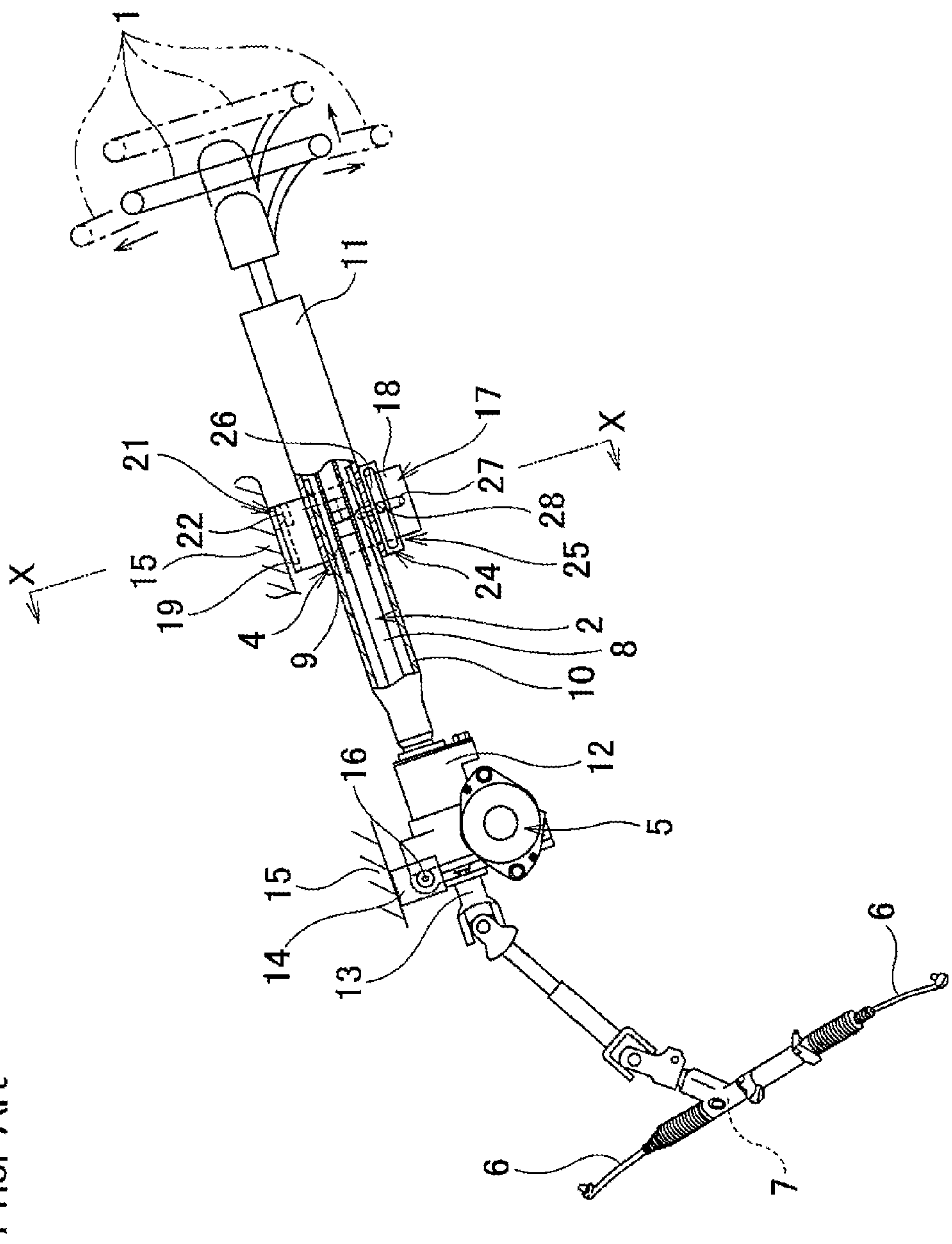
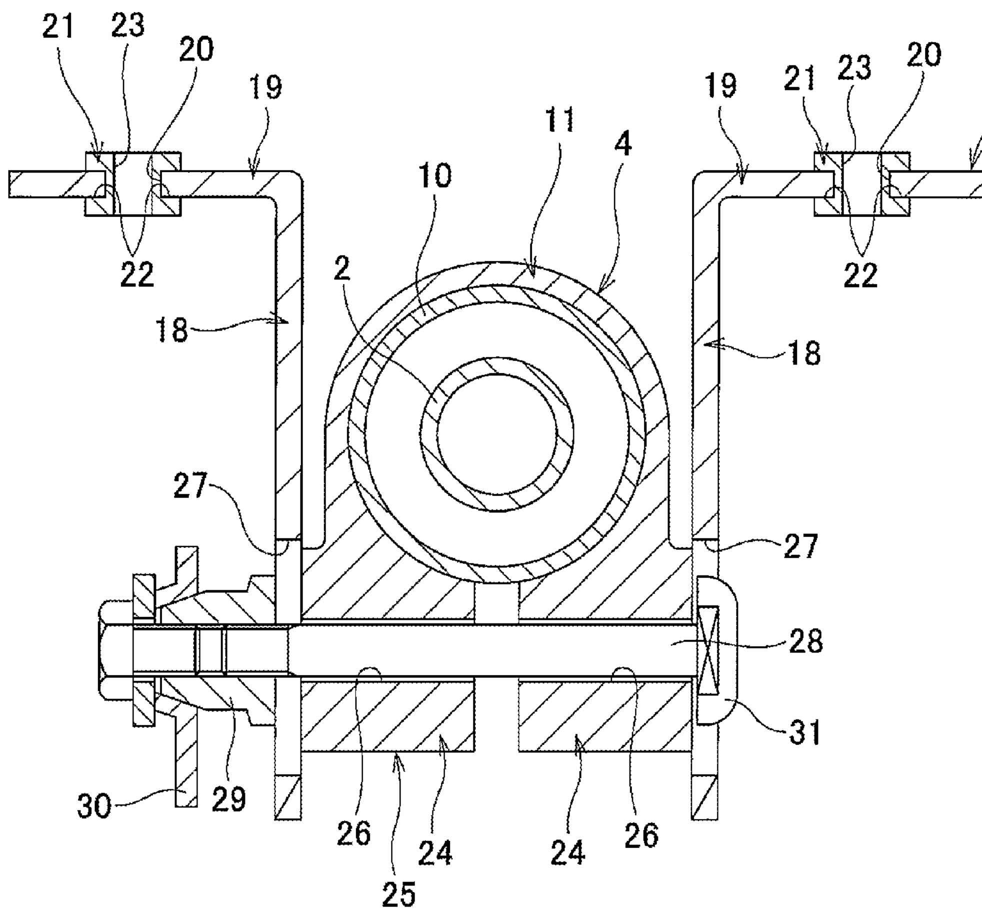



Fig.9
Prior Art

Fig.10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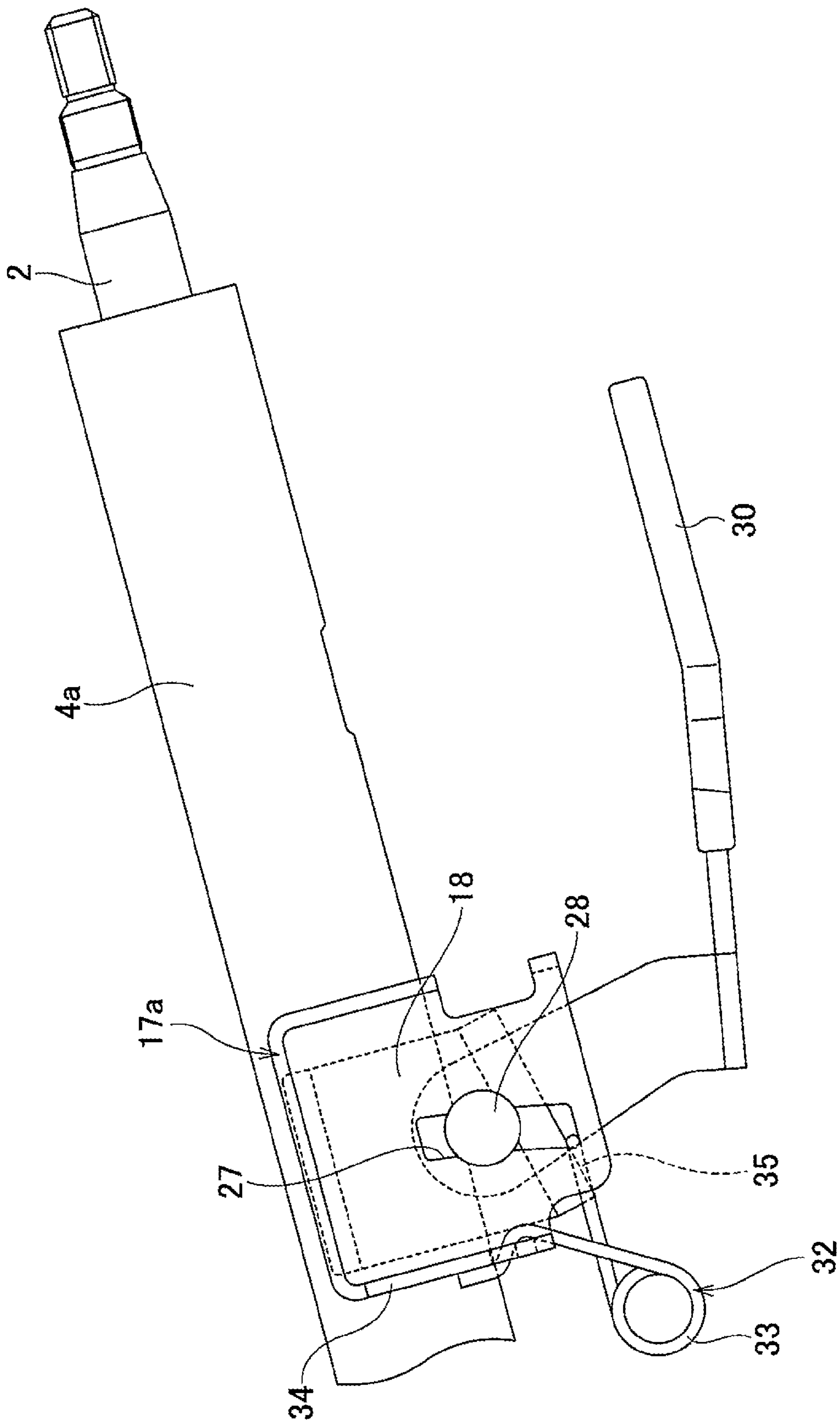


Fig.11
Prior Art

# TILT STEERING APPARATUS

## TECHNICAL FIELD

The present invention relates to a tilt steering apparatus that has a tilt mechanism for adjusting the up-down position of a steering wheel, and a shock-absorbing apparatus for protecting a driver that collides with the steering wheel during a collision accident.

## BACKGROUND ART

As illustrated in FIG. **8**, a steering apparatus is constructed so that movement of a steering wheel **1** is transmitted to a steering gear by way of a steering shaft **2**, and a steering angle is applied to steered wheels **3** on the left and right. Moreover, the positional relationship between the steering wheel **1** and the driver changes depending on the size and driving posture of the driver, so tilt and telescopic steering apparatuses that have a function for adjusting the forward-backward position and up-down position of the steering wheel **1** are widely used.

FIG. **9** and FIG. **10** illustrate a conventional tilt and telescopic steering apparatus as disclosed in JP 2011-218941 (A). This steering apparatus has an electric powered power-steering apparatus that has: a steering shaft **2** that has a rear end to which a steering wheel **1** is fastened; a steering column **4** that supports the steering shaft **2** on the inside thereof so as to rotate freely; a steering-assist apparatus **5** that applies an assist torque to the steering shaft **2**; and a steering gear unit **7** for causing tie rods **6** to displace based on the rotation of the steering shaft **2**. In this specification, the forward-backward direction is the forward and backward direction of the vehicle.

The steering shaft **2** has an inner shaft **8** and outer shaft **9** that are combined together so as to be capable of transmitting rotation force, and capable of relative displacement in the axial direction. By the displacement in the axial direction of the inner shaft **8** and outer shaft **9**, it becomes possible to not only adjust the forward-backward position of the steering wheel **1**, but by the entire length of the steering shaft **2** contracting during a collision accident, it becomes possible to lessen impact on the driver that collides with the steering wheel **1**.

The steering column **4** is formed by fitting the portion on the front-end side of an outer column **11** that is arranged on the rear side around the outside of the portion on the rear-end side of an inner column **10** that is arranged on the front side so that relative displacement is possible in the axial direction, and so as to be capable of extending or contracting in the axial direction with the steering shaft **2**. The front-end section of the inner column **10** is connected and fastened to the rear-end surface of a gear housing **12** of the steering-assist apparatus **5**. Moreover, the inner shaft **8** is inserted inside the gear housing **12**, and the front-end section of the inner shaft **8** is connected to the input shaft of the steering-assist apparatus **5**. The output shaft **13** of the steering-assist apparatus **5** is linked to the input shaft by way of a torsion bar, and the front-end section of the output shaft **13** protrudes from the front-end surface of the gear housing **12** and is linked to the steering-gear unit **7** by way of an intermediate shaft and universal joint.

The inner column **10** is supported by part of the vehicle body **15** by way of the gear housing **12** and a front-side support bracket **14**. The gear housing **12** is supported by the front-side support bracket **14** so as to be able to pivot freely around a pivot shaft **16**. The portion near the front end of the outer column **11** is supported by part of the vehicle body **15** by way of a rear-side support bracket **17**. The rear-side support bracket **17** is supported by the vehicle body **15** so as to be able to separate in the forward direction when a strong impact is applied in the forward direction.

As illustrated in FIG. **10**, in order to make it possible for the rear-side support bracket **17** to separate in the forward direction, connecting plates **19** are provided on the top-end sections of both of a pair of left and right support-plate sections **18** of the rear-side support bracket **17** so as to protrude out in a direction toward the sides of the steering column **4**. Notches **20** are provided in the connecting plates **19** and are open on the rear-end edges of the connecting plates **19**. Capsules **21** that are fastened to the vehicle body by bolts (not illustrated in the figure) are locked into the notches **20**. Engaging grooves **22** for engaging with the edges on the left and right of the notches **20** of the connecting plates **19** are formed on the surfaces of the left and right sides of the capsules, and through holes **23** in the up-down direction through which the bolts are inserted are formed in the middle sections of the capsules **21**.

During a collision accident, the driver's body applies a large impact load in the forward direction to the steering column **4** by way of the steering wheel **1** and steering shaft **2**. As a result, the steering shaft **2** and steering column **4** have a tendency to contract over the entire length while absorbing the impact energy. When this happens, the rear-side support bracket **17** has a tendency to displace in the forward direction together with the outer column **11**, however, both of the capsules **21** stay in their original positions together with the bolts. As a result, the capsules **21** come out toward the rear from the notches **20**, which allows the steering wheel **1** to displace in the forward direction. A shock-absorbing mechanism that is constructed in this way absorbs the impact energy that is applied to the steering wheel **1** from the driver, and protects the driver.

Moreover, in order to make it possible to adjust the forward-backward position and the up-down position of the steering wheel **1**, the outer column **11** is supported by the rear-side support bracket **17** so as to be able to displace in the forward-backward direction and in the up-down direction. More specifically, a column-side bracket **25** that has a pair of held sections **24** that are separated from each other in the width direction are integrally provided on the bottom surface of the front-end section of the outer column **11**. Column-side through holes **26** that extend in the forward-backward direction are formed in the held sections **24** at positions that are aligned with each other. Moreover, vehicle-side through holes **27** that extend in the up-down direction are formed in portions of the support-plate sections **18** of the rear-side support bracket **17** that are aligned with each other and that are aligned with part in the forward-backward direction of the column side through holes **26**. When the held sections **24** are held by the support-plate sections **18** of the support bracket **17**, a rod-shaped member **28** is inserted through the column-side through holes **26** and vehicle-side through holes **27** from one end to the other (from the right side to the left side in FIG. **10**), and a connecting nut **29** is screwed on the other end of the rod-shaped member **28**. The connecting nut **29** can be freely turned by an adjustment lever **30**.

The connecting nut **29** is rotated by the operation of the adjustment lever **30**, and by expanding or contracting the space between the connecting nut **29** and the head section of the rod-shaped member **28**, it is possible to expand or contact the space between the support-plate sections **18**, which fastens or unfastens the outer column **11** to or from the rear-side support bracket **17**; and it is possible to expand or contract the space between the held sections **24**, which fastens or unfastens the outer column **11** to or from the inner column **10**. With this kind of construction, when the space between the connecting nut **29** and the head section **31** is in the expanded state, it is possible to adjust the forward-backward position of the steering wheel **1** by causing the outer column **11** to displace in the forward-backward direction relative to the inner column **10** within the range (telescopic adjustment range) that the rod-shaped member **28** is able to displace inside the column-side through holes **26**. Moreover, it is possible to adjust the up-down position of the steering wheel **1** by causing the steering column **4** to pivotally displace around the pivot shaft **16** within the range (tilt adjustment range) that the rod-shaped member **28** is able to displace inside the vehicle-side through holes **27**.

On the other hand, FIG. **11** illustrates a conventional tilt steering apparatus that is disclosed in JP 2006-159920 (A) and has a bias spring **32** that applies a pressure force in the upward direction to the steering column **4***a*. The bias spring **32** is a so-called double-torsion spring that is formed, for example, by bending single wire that is made of spring steel, and is assembled so that a pair of coil-spring sections **33** that are provided on the portions near both ends of the wire are arranged so as to be in front of the rear-side bracket **17***a,* and by turning the pair of coil-spring sections **33**, a tensile force is generated by these coil-spring sections **33** in the direction turned, and in that state, both end sections of the bias spring **32** engage with part of a front-plate section **34** that is provided on the front end of the rear-side support bracket **17***a,* and a pressure section **35** that is formed by the middle section of the wire causes a pressure force to act in the upward direction on the steering column **4***a*.

By providing the bias spring **32**, when the adjustment lever **30** is operated, the steering column **4***a* is prevented from pivoting downward due to gravity, and it is also possible to reduce the force needed when adjusting the height position of the steering column **4***a*. However, when the bias spring **32** is applied as a support mechanism for a steering column **4** in a tilt and telescopic steering apparatus that has the shock-absorbing mechanism illustrated in FIG. **9** and FIG. **10**, there is a possibility that during a secondary collision, the bias spring **32** will also displace in the forward direction together with the outer column **11** and rear-side support bracket **17** to which both end sections of the bias spring **32** are fastened, and that the coil-spring sections **33** will collide against a member such as the gear housing **12** of a steering-assist apparatus **5** that is located further toward the front than the bias spring **32**, and the bias spring **32** will be prevented from further displacement in the forward direction.

When the rear-side support bracket **17** and outer column **11** try to displace further in the forward direction with the bias spring **32** prevented from further displacement in the forward direction, there is a possibility that unless the fastened state of the bias spring **32** to the rear-side support bracket **17***a* is released, the bias spring **32** will be stuck between the rear-end section of the gear housing **12** and the rear-side support bracket **17**, and will obstruct smooth displacement in the forward direction of the rear-side support bracket **17** and the outer column **11**.

Moreover, even when the fastened state of the bias spring **32** to the rear-side support bracket **17** is released during a secondary collision, there is a possibility that as the rear-side support bracket **17** displaces further in the forward direction, the rear-side support bracket **17** and the coil-spring sections **33** will interfere with each other in the forward-backward direction, and will obstruct displacement of the rear-side support bracket **17***a* in the forward direction, and prevent smooth displacement in the forward direction of the rear-side support bracket **17** and outer column **11**. A similar situation also occurs when a shock-absorbing mechanism that allows displacement in the forward direction of the steering column **4***a* and rear-side support bracket **17** during a secondary collision is applied to the tilt steering apparatus illustrated in FIG. **11**.

## RELATED LITERATURE

### Patent Literature

[Patent Literature 1] JP 2011-218941 (A)
[Patent Literature 2] JP 2006-159920 (A)

## SUMMARY OF INVENTION

### Problem to be Solved by Invention

The object of the present invention is to provide construction of a tilt steering apparatus that has a shock-absorbing mechanism in which, even when a bias spring is applied that causes a pressure force to act on the steering column in the upward direction, the steering column and support bracket can displace smoothly in the forward direction during a secondary collision without interference from the bias spring.

### Means for Solving Problem

The present invention relates to a tilt steering apparatus having a bias spring that is provided so as to span between a steering column and a support bracket, and causes an upward pressure force to act on the steering column, and is characterized in that, during the stroke through which the steering column and the support bracket are able to displace in the forward direction during a secondary collision, when the bias spring displaces in the forward direction with these members and interferes in the forward-backward direction with a member that is located further toward the front than the bias spring, a locked state of the bias spring against the support bracket is released, which allows the steering column and the support bracket to further displace in the forward direction. In the present invention, the stroke is the length though which the steering column is able to contract in the forward-backward direction (axial direction) during a secondary collision in the case of construction that has a telescopic mechanism, or is the length through which the steering column is able to displace in the forward direction during a secondary collision in the case of construction that does not has a telescopic mechanism.

More specifically, the tilt steering apparatus of the present invention has a steering column, a support bracket and a bias spring. The steering column has a front section that is supported by a portion fixed to a vehicle body by way of a pivot shaft that is arranged in the width direction, the steering column being able to pivotally displace around the pivot shaft, and supporting a steering shaft on the inside thereof so as to freely rotate. A steering wheel is supported by and fastened to the rear-end section of this steering shaft. The support bracket has a connecting-plate section that is supported by the vehicle body so as to be able to separate in the forward direction, and a pair of support-plate sections that are fastened to the connecting-plate section so as to be suspended downward, and by expanding or contracting the space between, are capable of a state of holding the steering column from both sides in the width direction, and a state of allowing the pivotal displacement of the steering column.

More specifically, a column-side bracket is provided in part in the axial direction of the steering column. Moreover, vehicle-side through holes are provided in portions of the pair of support-plate sections that are aligned with each other so as to extend in the up-down direction, and a column-side through holes is provided in a portion of the column-side bracket that is aligned with the vehicle-side through holes so as to penetrate through in the width direction of the column-side bracket. In the case of a steering apparatus that has a telescopic mechanism, the column-side through hole extends in the forward-backward direction. A rod-shaped member is provided so as to be inserted in the width direction through the vehicle-side through holes and the column-side through hole, and the rod-shaped member has a mechanism that expands or contracts the space between the pair of support-plate sections. Furthermore, an adjustment lever is provided on the end section of the rod-shaped member, and as the adjustment lever rotates, the mechanism that expands or contracts the space between the pair of support-plate sections operates.

The bias spring is assembled between the steering column and the support bracket so as to be able to displace in the forward direction together with the steering column and the support bracket, and is constructed so as to apply an upward pressure force to the steering column.

Particularly, in the tilt steering apparatus of the present invention, the bias spring has a pair of locking-arm sections and a pressure section. A spring-side locking section is formed in part of each of the pair of locking-arm sections, and the spring-side locking sections are locked with bracket-side locking sections that are formed in the support bracket. The pressure section is directly or indirectly locked with part of the steering column, and causes an upward pressure force to act on the steering column with the spring-side locking sections as a fulcrum. The tilt steering apparatus of the present invention is also constructed so that when the bias spring interferes in the forward-backward direction with a member that is located further toward the front than the bias spring during the stroke through which the steering column and the support bracket are able to displace in the forward direction during a secondary collision, the locked state between the spring-side locking sections and the bracket-side locking sections is released, the bias spring stops in that place and does not displace in the forward direction, and the steering column and support bracket are allowed to further displace in the forward direction.

Preferably, the tilt steering apparatus of the present invention is constructed so that, when the locked state of the spring-side locking sections against the bracket-side locking sections is released and the steering column and the support bracket displace further in the forward direction, there is no interference in the forward-backward direction between the bias spring and the support bracket.

Preferably, the bias spring is made of a single wire and has a pair of coil-spring sections, wherein the pressure section is formed by bending the middle section of the wire, and the pair of coil-spring sections are formed by winding the portions near both ends of the wire into a spiral shape, and so as to be separated from each other in the width direction; the pair of locking-arm sections are formed from both end sections of the wire in a state so as to extend toward the rear from the end sections on the opposite side from the pair of coil-spring sections, and the bracket-side locking sections are provided on the side surfaces in the width direction of the pair of support-plate sections.

In this case, preferably, the pair of coil-spring sections are located further toward the front than the pair of support-plate sections and do not overlap the pair of support-plate sections in the forward-backward direction, and are located in positions that are aligned in the width direction with the pair of locking-arm sections.

Moreover, preferably, the pair of coil-spring sections and the pair of locking-arm sections are located further on the outside in the width direction than the pair of support-plate sections, and the bracket-side locking sections are provided on the outside surfaces in the width direction of the pair of support-plate sections.

The tilt steering apparatus of the present invention preferably further has a guiding member that is supported by the portion fixed to the vehicle body, and guides the support bracket in the forward direction while preventing the support bracket from dropping. In this case, spring-side guiding sections that are parallel or nearly parallel on the top and bottom with respect to the direction that the guiding member guides the support bracket are provided in the portions of the pair of locking-arm sections that come in sliding contact with the bracket-side locking sections during a secondary collision.

In the tilt steering apparatus of the present invention, preferably a coating layer made of a low-friction material is formed on the spring-side locking sections. Alternatively, grease is preferably applied to the engaging portions between the spring-side locking sections and the bracket-side locking sections.

## Effect of Invention

With the tilt steering apparatus of the present invention, it is possible to allow the steering column and support bracket to displace smoothly in the forward direction during a secondary collision. In other words, in the present invention, during a secondary collision, when the bias spring that displaces in the forward direction together with the steering column and support bracket interferes with another member in the forward-backward direction, the locked state between the spring-side locking sections of the bias spring and the bracket-side locking sections of the support bracket is released. Therefore, during the stroke through which the steering column and support bracket are able to displace in the forward direction, the bias spring does not stick in between another member and the support bracket. As a result, the steering column and the support bracket are allowed to smoothly displace during a secondary collision.

Moreover, in the tilt steering apparatus of the present invention, by employing construction in which there is no interference in the forward-backward direction between the bias spring and the support bracket when the locked state between the bias spring and the support bracket is released and the steering column and the support bracket further displace in the forward direction, it becomes possible to maintain a large stroke during a secondary collision, and it is possible to allow the steering column and the support bracket to smoothly displace over that entire stroke.

## BRIEF DESCRIPTION OF DRAWINGS

FIG. **1** illustrates a side view of a tilt and telescopic steering apparatus of an example of an embodiment of the present invention in the normal state.

FIG. **2** is a bottom view as seen from the bottom in FIG. **1**.

FIG. **3** is a side view of the apparatus illustrated in FIG. **1** in the state in which the outer column and support bracket are in the progress of displacing in the forward direction during a secondary collision.

FIG. **4** is a bottom view as seen from the bottom in FIG. **3**.

FIG. **5** is a side view of the apparatus illustrated in FIG. **1** in the state in which the outer column and support bracket have displaced all the way in the forward direction during a secondary collision.

FIG. **6** is a bottom view as seen from the bottom in FIG. **5**.

FIG. **7** is a perspective view of the support bracket, capsule and guide member that have been removed from the apparatus illustrated in FIG. **1** as seen at an angle from the rear.

FIG. **8** is a perspective view illustrating an example of a steering apparatus.

FIG. **9** is a partial cross-sectional side view illustrating an example of a conventional tilt and telescopic steering apparatus.

FIG. **10** is a cross-sectional view of section X-X in FIG. **9**.

FIG. **11** is a side view illustrating an example of a tilt steering apparatus that has a conventional bias spring.

## MODES FOR CARRYING OUT INVENTION

FIG. **1** to FIG. **7** illustrate an example of an embodiment of the present invention. In this example, the present invention is applied to a tilt and telescopic steering apparatus that makes it possible to adjust both the height position and the forward-backward position of a steering wheel. More specifically, the tilt and telescopic steering apparatus of this example has: a steering column **4***b* that is formed by combining an inner column **10** that is located on the front side with an outer column **11***a* that is located on the rear side; a support bracket **17***b* that is supported by the vehicle body **15** so as to be able to separate in the forward direction, and has a pair of support-plate sections **18***a* that are formed so as to be located on both sides in the width direction of the steering column **4***b;* and a bias spring **32***a* that is installed between the steering column **4***b* and support bracket **17***b* in a state so as to be able to displace in the forward direction with the steering column **4***b* and support bracket **17***b,* and applies an upward pressure force to the steering column **4***b*.

The steering column **4***b* has a front section that is supported by a portion fixed to the vehicle body by way of a pivot shaft **16** that is arranged in the width direction, and is able to pivotally displace around the pivot shaft **16**; and supports the steering shaft **2** on the inside thereof, the steering wheel **1** being supported by and fastened to the rear-end section of the steering shaft **2**. In construction in which the front section of the steering column **4***b* is supported by a portion that is fastened to the vehicle body by way of a front-side support bracket **14** (see FIG, **9**) so as to be able to pivotally displace, the support bracket **17***b* corresponds to a so-called rear-side support bracket.

A column-side bracket **25***a* is provided in part in the axial direction of the outer column **11***a* of the steering column **4***b*. Moreover, vehicle-side through holes **27** that extend in the up-down direction are provided in portions of the pair of support-plate sections **18***a* that are aligned with each other, and a column-side through hole **26** that extends in the forward-backward direction is provided so as to penetrate in the width direction through a portion of the column-side bracket **25***a* that is aligned with the vehicle-side through holes **27**. A rod-shaped member **28** is provided so as to be inserted in the width direction through the vehicle-side through holes **27** and the column-side through hole **26**, and the rod-shaped member **28** has a mechanism for expanding or contracting the space between the pair of support-plate sections **18***a*. In addition to a mechanism that has a head section of the rod-shaped member **28** and a nut that screws on the tip-end section of the rod-shaped member **28**, it is possible to also employ a mechanism that uses a cam apparatus as this kind of mechanism. An adjustment lever **30** is provided on the end section of the rod-shaped member **28**, and as the adjustment lever **30** rotates, the mechanism that expands or contracts the space between the pair of support-plate sections **18***a* operates and switches between a state in which the outer column **11***a* of the steering column **4***b* is held on both sides in the width direction, and a state in which the steering column **4***b* is able to pivotally displace.

A feature of this example is devising the shape and support mechanism of a bias spring **32***a* of a tilt and telescopic steering apparatus with a shock-absorbing mechanism that causes an upward pressure force to act on the steering column **4***b*. Except for the feature of this example, the construction of the tilt and telescopic steering apparatus is the same as the conventional construction, so an explanation of that construction will be omitted or simplified, and the explanation below will center on the feature of this example.

The support bracket **17***b* of the tilt and telescopic steering apparatus of this example has a pair of left and right support-plate sections **18***a* that are provided underneath an upper bracket **43**. The upper bracket **43** is one plate-shaped member that extends in the width direction, and has a pair of left and right connecting-plate sections **19***a,* and a continuous-plate section **44** that is provided in the width direction between the connecting-plate sections **19***a*. The continuous-plate section **44** protrudes further upward than the connecting-plate sections **19***a* on both sides, and connects the inside ends in the width direction of the connecting-plate sections **19***a*. Moreover, a guided-side through hole **45** that penetrates through the continuous-plate section **44** in the up-down direction is formed in a portion near the rear end of the center section in the width direction of the continuous-plate section **44**.

The top-end sections of the pair of support-plate sections **18***a* are connected and fastened to the bottom surface of the continuous sections between the pair of connecting-plate sections **19***a* and the continuous-plate section **44** by a method such as welding or the like. Locking tabs **41** that are formed by bending part outward in the width direction are provided in portions near the frond ends of the middle sections in the up-down direction of the support-plate sections **18***a*. The locking pieces **41** correspond to the bracket-side locking sections of the present invention. The construction of the bracket-side locking sections is not limited to locking tabs **41**, and it is also possible to employ other arbitrary locking construction such as protrusions for the bracket-side locking sections. Moreover, in this example, the length dimension in the up-down direction of a pair of front-plate sections **34***a* of the support bracket **17***b* is small, and the position of the edge on the bottom end of the front-plate sections **34***a* is located further upward than that of the conventional construction. As a result, together with preventing interference in the forward-backward direction between these front-plate sections **34***a* and the bias spring **32***a,* it is possible to improve the ability of assembling the bias spring **32***a* with respect to the support bracket **17***b*.

In this example, a guiding member **46** that guides the displacement in the forward direction of the support bracket **17***b* while preventing the support bracket **17***b* from dropping during a secondary collision is provided between the vehicle body **15** and the top surface of the upper bracket **43** of the support bracket **17***b*. The guiding member **46** is a single plate-shaped member that is long in the width direction, and has a pair of left and right fastening-plate sections **47** and a guiding-plate section **48** that is provided in the center section in the width direction. Fastening through holes **49** that penetrate in the up-down direction through the fastening-plate sections **47** are formed in the center sections of the fastening-plate sections **47**. Moreover, a pair of fastening-flange sections **50** is formed on both sides in the width direction of the front-end sections of these fastening-plate sections **47** so as to protrude outward in the width direction. Small fastening-side through holes **51** that penetrate in the up-down direction though the fastening-flange sections **50** are formed in these fastening-flange sections **50**.

The guiding-plate section **48** protrudes further upward than the fastening-plate sections **47** on both sides, and connects the inside ends in the width direction of the fastening-plate sections **47**. In other words, the guiding member **46** has a shape that follows the top surface of the upper bracket **43**. Moreover, a long guiding-side hole **52** having a width dimension that is a little larger than the diameter of the guided-side through hole **45** and that extends in forward-backward direction is formed at a position in the center section in the width direction of the guiding-plate section **48** that in the assembled state is aligned in the width direction and forward-backward direction with the guided-side through hole **45** of the continuous-plate section **44** of the upper bracket **43**.

The guiding member **46** is placed above the upper bracket **43** in which the capsules **21** are assembled, and with the fastening through holes **49** of the fastening-plate sections **47** aligned with the through holes **23** in the up-down direction of the capsules **21**, the guiding member **46** is fastened to the vehicle body **15** by bolts (not illustrated in the figure) for fastening the capsules **21** to the vehicle body. Moreover, the front-end section of the guiding member **46** is connected and fastened to the vehicle body **15** by bolts (not illustrated in the figure) that pass downward through the small fastening-side trough holes **51** of the fastening-flange sections **50**. Therefore, the guiding member **46** is prevented from displacement in the forward-backward direction with respect to the vehicle body **15** during a secondary collision. In this way, when the guiding member **46** is connected and fastened to the vehicle body **15**, the guided-side through hole **45** of the continuous-plate section **44** and the rear-end section in the forward-backward direction of the long guiding-side hole **52** of the guiding member **46** are aligned.

Together with inserting the shaft section of a bolt **53**, the head section thereof being located under the continuous-plate section **44**, through the guided-side though hole **45** and the long guiding-side through hole **52**, a nut **54** is screwed onto a male screw section that is formed on a portion of that shaft section that protrudes further upward than the guiding-plate section **48**. In this state, the continuous-plate section **44** and guiding-plate section **48** are not firmly held between the head section of the bolt **53** and the nut **54**, and are connected so that the upper bracket **43** is able to displace in the forward-backward direction with respect to the guiding member **46**. In other words, with the guiding member **46** and the support bracket **17***b* in a connected state, the support bracket **17***b* is supported in a suspended state by the guiding member **46**, and displacement in the forward-backward direction is guided by the guiding member **46**. In this example, a sliding plate **55** is provided between the top surface of the continuous-plate section **44** of the support bracket **17***b* and the bottom surface of the nut **54**, so that the portion of the shaft section of the bolt **53** that protrudes further upward than the guiding-plate section **48** is inserted into a through hole that is formed in the center of the sliding plate **55**. As a result, the support bracket **17***b* is more smoothly guided in the forward-backward direction by the guiding member **46**. The construction for guiding the support bracket **17***b* by the guiding member **46** is not limited to the construction of this example, and it is also possible to employ various kinds of known construction in which the support bracket is guided by the guiding member by direct or indirect interaction between the guiding member that is fastened to the vehicle body and the support bracket.

The bias spring **32***a* of the tilt and telescopic steering apparatus of this example spans between the outer column **11***a* of the steering column **4***b* and the support bracket **17***b*, and in the assembled state, applies an upward pressure force on the outer column **11***a* of the steering column **4***b*, and balances the weight of the steering column **4***b* and the member that rises together with the steering column **4***b*. The bias spring **32***a* in this example has so-called double-torsion spring construction, and is constructed by a single wire made of spring steel, and has: a pair of coil-spring sections **33***a*, a pressure section **35***a* that is provided in the portion between the coil-spring sections **33***a* in the width direction, and a pair of locking-arm sections **36**. However, the bias spring of the present invention is not limited to the construction of this example, and it is also possible to employ a spring having arbitrary construction in which two torsion springs or the like span between the steering column **4***b* and the support bracket **17***b* and achieve the feature of the present invention.

The coil-spring sections **33***a* are formed by winding the portions near both ends of the wire material into a spiral shape, so as to be concentric with each other and separated from each other in the width direction. The pressure section **35***a* is formed by performing a bending process on the middle section of the wire material and bending that middle section back into a U shape so that the pressure section **35***a* has a pair of straight sections **37** that are parallel with each other, and an arc-shaped first connecting section **38** that connects together the rear-end sections of these straight sections **37**. The front-end sections of the pair of straight sections **37** and the end sections on the sides of the coil-spring sections **33***a* on both sides that face each other are connected by a second connecting section **39**. In the assembled state, the portion of the second connecting section **39** that is located in front of the support-plate sections **18***a* (portion near the outside end in the width direction) is preferably located toward the front as far as possible. In doing so, the second connecting section **39** does not obstruct displacement in the forward direction of the support bracket **17***b* during a secondary collision.

Moreover, the pair of locking arm sections **36***a* are formed from both end sections of the wire material such that the overall length is long in the forward-backward direction, and so as to have a straight shape as seen in the up-down direction, and to have a zig-zag shape (triangular wave shape) as seen from the side. Moreover, L-shaped spring-side locking sections **40** are formed by bending the portions near the rear ends of the locking arm sections **36** so that the wire material protrudes upward a little (so that the bending angle forms an obtuse angle).

In this example, the portions of the pair of locking arm sections **36** that come in sliding contact with the locking tabs **41** during a secondary collision, or in other words, the portions (portions indicated by α in FIG. **1**) from the front ends of the spring-side locking sections **40** to the positions that are aligned with the locking tabs **41** in the forward-backward direction when the steering column **4***b* and support bracket **17***b* have fully displaced in the forward direction (state illustrated in FIG. **5**) function as spring-side guiding sections **56** that are arranged vertically in parallel or nearly in parallel with respect to the direction that the guiding member **46** guides the support bracket **17***b* (forward-backward direction). In other words, the spring-side guiding sections **56** are arranged vertically in parallel or nearly in parallel with respect to the top surface of the guiding-plate section **48**. In the case of forming a zig-zag shape with plural straight sections that are inclined a little (two in this example) with respect to the top surface of the guiding-plate section **48** as in this example, the pair of locking-arm sections **36** are arranged so that the average values of incline of these straight sections become vertically in parallel or nearly in parallel with respect to the direction that the guiding member **46** guides the support bracket **17***b*. Alternatively, in the case where the spring-side guiding sections **56** are formed into an overall wave shape with gentle curves, the pair of locking-arm sections **36** are arranged so that the virtual lines found by linear approximation become vertically in parallel or nearly in parallel with respect to the direction that the guiding member **46** guides the support bracket **17***b*. The front-end sections of these locking-arm sections **36** are connected to the end sections on the opposite side of the pair of coil-spring sections **3***a* so that the locking-arm sections **36** extend toward the rear from these end sections. Moreover, these coil-spring sections **33***a* and locking-arm sections **36** are formed at positions that are nearly aligned in the width direction. In other words, the coil-spring sections **33***a* and locking-arm sections **36** are provided in a state so as to be nearly overlapping in the forward-backward direction. It is also possible to provide these locking-arm sections **36** further outward in the width direction than the coil-spring sections **33***a*.

In this example, the bias spring **32***a* is completely covered by a coating layer of a low-friction material. This low-friction coating layer can be formed by various kinds of surface processing such as PTFE (polytetrafluoroethylene) coating, fluorine coating, molybdenum disulfide coating, zinc phosphate film processing or the like. This coating layer can be formed over the entire bias spring **32***a* as in this example, or can also be formed on only the portion of the bias spring **32***a* that comes in contact with the support bracket **17***b*, outer column **11***a* of the steering column **4***b*, or other surrounding members such as the rod-shaped member **28**. By limiting the portion where the coating layer is formed in this way, it is possible to keep down the processing cost for forming this coating layer.

This kind of bias spring **32***a* is arranged so that the coil-spring sections **33***a* are further on the front side than the support bracket **17***b*, and by turning these coil-spring sections **33***a*, a tensile force in the turning direction is generated by these coil-spring sections **33***a*, and in this state, the half on the rear side of the spring-side locking sections **40** of the locking-arm sections **36** are locked with the top surface of the locking tabs **41** of the support bracket **17***b*, and the pressure section **35***a* engages with a receiving surface **42** that is provided on the bottom surface of the center section in the axial direction of the rod-shaped member **28**. In this state, the bias spring **32***a* applies a tensile force in the upward direction on the outer column **11***a* by way of the rod-shaped member **28**. The pressure section **35***a* is prevented from relative displacement in the forward-backward direction by just the friction force that acts between the pressure section **35***a* and the receiving surface **42**, and except for this, there is no special construction provided for suppressing relative displacement of the pressure section **35***a* in the forward-backward direction. Moreover, the receiving surface **42** could also be provided on the bottom end of the outer column **11***a*.

Furthermore, in this example, grease is applied to both the locking portion between the spring-side locking sections **40** of the pair of locking-arm sections **36** and the locking tabs **41** of the support bracket **17***b*, and the area of contact between the pressure section **35***a* and the receiving surface **42** of the rod-shaped member **28**. Taking into consideration lubrication and viscosity, an arbitrary type of grease can be suitably used as the grease, however, preferably a grease that has little dripping and scattering, prevents rust, can be used over a long period of time, and can be used in areas having wide range of operating temperatures should be used.

In the assembled state, the locking-arm sections **36** and the coil-spring sections **33***a* that are located on both sides of the bias spring **32***a* are located on the outside in the width direction of the pair of support-plate sections **18***a* of the support bracket **17***b*. In other words, the locking-arm sections **36** and coil-spring sections **33***a* are located at positions that do not overlap the support-plate sections **18***a* in the forward-backward direction. Moreover, the pressure section **35***a* of the bias spring **32***a* is located in the portion between the support-plate sections **18***a* in the width direction. Therefore, only the portion near the outside end in the width direction of the second connecting section **39** of the bias spring **32***a* is located in front of the support-plate sections **18***a*.

In the assembled state, the bias spring **32***a* presses the locking tabs **41** downward by way of the spring-side locking sections **40**. The bias spring **32***a* also causes a pressure force to act upward on the outer column **11***a* of the steering column **4***b* with the locking portions between the spring-side locking sections **40** and locking tabs **41** on both sides as fulcrums. This balances the pressure force (force that causes the steering column **4***b* to pivot upward around the pivot shaft **16**), and the weight (force=moment that is trying to cause the steering column **4***b* to pivot downward), and makes it possible during adjustment of the height of the steering wheel **1** to reduce the force necessary for causing the steering column **4***b* to pivot around the pivot shaft **16**. The spring-side locking sections **40** and locking tabs **41** engage with a locking force that keeps the bias spring **32***a* from shifting in the forward-backward direction when performing operation to adjust the height position and forward-backward position of the steering wheel **1**.

The tilt steering apparatus of this example is such that when the body of a driver collides with the steering wheel **1** during a secondary collision that occurs during a collision accident, the outer column **11***a* and support bracket **17***b* are allowed to displace in the forward direction from the normal position illustrated in FIG. **1** and FIG. **2** while the guiding member **46** and pair of left and right capsules **21** remain in place fastened to the vehicle body **15**. When this happens, the guiding member **46** prevents the support bracket **17***b* from falling, and guides the displacement of the support bracket **17***b* in the forward direction. Therefore, during a secondary collision, the support bracket **17***b* separates from the vehicle body **15** displaces in the forward direction along the guiding member **46**, and even as the secondary collision proceeds, the support bracket **17***b* will not drop. Therefore, during a secondary collision, regardless of the direction of the force that is applied to the steering wheel from the driver, the support bracket **17***b* stably displaces in the forward direction. Moreover, the bias spring **32***a* does not become disconnected due to impact caused by the support bracket **17***b* dropping, so the bias spring **32***a* also smoothly displaces in the forward direction together with the outer column **11***a* and support bracket **17***b*.

As illustrated in FIG. **3** and FIG. **4**, in the middle of the stroke in which the outer column **11***a* and support bracket **17***b* can displace in the forward direction, the portion near an outside end in the width direction of one of the second connecting sections **39** of the bias spring **32***a* (second connecting section at the bottom of FIG. **4**) comes in contact with a receiving surface **57** that is provided on the rear-end section of the gear housing **12** of the steering-assist apparatus **5**, which is a member that is located further in front of the bias spring **32***a*, and the bias spring **32***a* is prevented from further displacement in the forward direction.

In this example, of the rear-end section of the gear housing **12**, the receiving surface **57** that comes in contact with the one second connecting section **39** is provided on a virtual plane that is orthogonal to the direction of displacement (forward-backward direction) of the support bracket **17***b*. By providing a receiving surface **57** in this way, it is possible to stabilize the posture of the bias spring **32***a* during a secondary collision after the front-end section of the bias spring **32***a* (front-end section of the one second connecting section **39**) comes in contact with the receiving surface **57**. Moreover, in this example, the receiving surface **57** of the gear housing **12** is provided so as to only come in contact with the one second connecting section **39**, however, it is also possible to provide a receiving surface of the gear housing so as to come in contact with both second connecting sections **39**. With such construction, it is possible to further stabilize the posture of the bias spring **32** during a secondary collision after the front-end section of the bias spring **32***a* (front-end sections of both second connecting sections **39**) comes in contact with the receiving surface **57**.

On the other hand, a force acts trying to further cause the outer column **11***a* and support bracket **17***b* to displace in the forward direction. In a state in which the engagement between the spring-side locking sections **40** of the bias spring **32***a* and the locking tabs **41** of the support bracket **17***b* becomes disengaged, the bias spring **32***a* stops at that place, and in that state, the outer column **11***a* and support bracket **17***b* further displace in the forward direction, and as illustrated in FIG. **5** and FIG. **6**, fully displace in the forward direction. In this way, in this example, when the bias spring **32***a* interferes in the forward-backward with the receiving surface **57** that is provided on the rear-end section of the gear housing **12**, which is a separate member existing further in front, the locked state of the spring-side locking sections **40** of the bias spring **32***a* with the locking tabs **41**, which are the bracket-side locking sections of the support bracket **17***b*, is released. Therefore, during the stroke in the forward direction through which the outer column **11***a* of the steering column **4***b* and the support bracket **17***b* are able to displace, the bias spring **32***a* does not stick between the receiving surface **57** of the gear housing **12** and the support bracket **17***b*. As a result, the outer column **11***a* and the support bracket **17***b* are allowed to smoothly displace in the forward direction during a secondary collision.

Moreover, when moving from the state illustrated in FIG. **3** and FIG. **4** to the state illustrated in FIG. **5** and FIG. **6**, there is no interference in the forward-backward direction of the support bracket **17***b* and the bias spring **32***a*. Therefore, together with being able to maintain a large stroke during a secondary collision, it becomes possible for the outer column **11***a* and the support bracket **17***b* to smoothly displace in the forward direction over the entire length of this stroke. As the outer column **11***a* and the support bracket **17***b* displace in the forward direction, the locking tabs **41** cause the locking-arm sections **36** of the bias spring **32***a* to elastically deform upward, and in this state, the locking tabs **41** displace in the forward direction while sliding along the bottom ends of these locking-arm sections **36**, however, interference due to this kind of sliding contact does not prevent smooth displacement in the forward direction of the outer column **11***a* and support bracket **17***b*. Furthermore, the area of contact between the pressure section **35***a* of the bias spring **32***a* and the receiving surface **42** of the steering column **4***b* also does not prevent smooth displacement in the forward direction of the outer column **11***a* and support bracket **17***b*.

In this example, spring-side guiding sections **55** that are vertically in parallel or nearly in parallel with respect to the direction that the guiding member **46** guides the support bracket **17***b* are provided at least on the portions (portions indicated by a in FIG. **1**) of the locking-arm sections **36** of the bias spring **32***a* from the front ends of the spring-side locking sections **40** to the positions that are aligned in the forward-backward direction with the locking tabs **41** in the state in which the steering column **4***b* and support bracket **17***b* have displaced all the way in the forward direction. Therefore, after the bias spring **32***a* interferes with the rear-end section of the gear housing **12** during a secondary collision and the bias spring **32***a* stops and does not displace in the forward direction, it is possible for the displacement in the forward direction of the support bracket **17***b* with respect to the bias spring **32** to be performed smoothly.

Moreover, in this example, a coating layer made of a low-friction material is formed over the entire bias spring, and grease is applied to the portions of engagement between the spring-side locking sections **40** of the bias spring **32***a* and the locking tabs **41** of the support bracket **17***b*, and area of contact between the pressure section **35***a* and the receiving surface **42** of the rod-shaped member **28**. Therefore, after the bias spring **32***a* comes in contact with the rear-end section of the gear housing **12** during a secondary collision and displacement in the forward direction of the bias spring **32***a* is prevented, it is possible to smoothly perform displacement in the forward direction of the outer column **11***a* and the support bracket **17***b* with respect to the bias spring **32***a*. Moreover, it is possible to prevent the occurrence of noise due to rubbing, friction, vibration and the like in these engaged portions and areas of contact. The coating layer of low-friction material should be formed on at least the spring-side locking sections **40** of the bias spring **32***a*. It is also possible to apply the grease to only the engaged portions between the spring-side locking sections **40** and the locking tabs **41** of the support bracket **17***b*.

## INDUSTRIAL APPLICABILITY

The present invention can be widely applied to no only tilt and telescopic steering apparatuses, but can also be applied to tilt steering apparatuses that has a shock-absorbing mechanism regardless of whether or not there is a telescopic mechanism.

## EXPLANATION OF REFERENCE NUMBERS

**1** Steering wheel
**2** Steering shaft
**3** Steered wheels
**4**, **4***a*, **4***b* Steering column
**5** Steering-assist apparatus
**6** Tie rod
**7** Steering gear unit
**8** Inner shaft
**9** Outer shaft
**10** Inner column
**11**, **11***a* Outer column
**12** Gear housing
**13** Output shaft
**14** Front-side support bracket
**15** Vehicle body
**16** Pivot shaft
**17**, **17***a* Support bracket (Rear-side support bracket)
**18**, **18***a* Support-plate section
**19**, **19***a* Connecting plate
**20** Notch
**21** Capsule
**22** Engaging groove
**23** Through hole in the up-down direction
**24** Held section
**25**, **25***a* Column-side bracket
**26** Column-side through hole
**27** Vehicle-side through hole

**28** Rod-shaped member
**29** Connecting nut
**30** Adjustment lever
**31** Head section
**32**, **32***a* Bias spring
**33**, **33***a* Coil-spring section
**34**, **34***a* Front-plate section
**35**, **35***a* Pressure section
**36** Locking-arm section
**37** Straight section
**38** First connecting section
**39** Second connecting section
**40** Spring-side locking section
**41** Locking tab
**42** Receiving surface
**43** Upper bracket
**44** Continuous-plate section
**45** Guided-side through hole
**46** Guiding member
**47** Fastening-plate section
**48** Guiding-plate section
**49** Fastening through hole
**50** Fastening flange section
**51** Small fastening-side through hole
**52** Long guiding-side hole
**53** Bolt
**54** Nut
**55** Sliding plate
**56** Spring-side guiding section
**57** Receiving surface

What is claimed is:

**1**. A tilt steering apparatus comprising:

a steering column having a front section that is supported by a portion fixed to a vehicle body by way of a pivot shaft that is arranged in a width direction of the vehicle body, the steering column being able to pivotally displace around the pivot shaft and supporting a steering shaft on an inside of the steering column so as to freely rotate;

a support bracket having a connecting-plate section that is supported by the vehicle body so as to be able to separate in a forward direction of the vehicle body, and a pair of support-plate sections that are fastened to the connecting-plate section so as to be suspended downward, and by expanding or contracting a space between the pair of support-plate sections, are capable of a state of holding the steering column from both sides in the width direction, and a state of allowing the pivotal displacement of the steering column; and

a bias spring assembled between the steering column and the support bracket in a state of being able to displace in the forward direction together with the steering column and the support bracket, and applying a upward pressure force to the steering column;

the bias spring comprising a pair of locking-arm sections and a pressure section;

the pair of locking-arm sections having spring-side locking sections that are formed in part thereof, and the spring-side locking sections being locked with bracket-side locking sections that are formed in the support bracket;

the pressure section being directly or indirectly locked with part of the steering column, and causing an upward pressure force to act on the steering column with the spring-side locking sections as a fulcrum; and

when the bias spring interferes in a forward-backward direction of the vehicle body with a member that is located further in front of the bias spring during a stroke through which the steering column and the support bracket are able to displace in the forward direction during a secondary collision, a locked state between the spring-side locking sections and the bracket-side locking sections being released, the bias spring stopping in a place without displacing in the forward direction, and the steering column and the support bracket being allowed to further displace in the forward direction.

**2**. The tilt steering apparatus according to claim **1**, wherein when the locked state between the spring-side locking sections and the bracket-side locking sections is released and the steering column and the support bracket displace further in the forward direction, there is no interference in the forward-backward direction between the bias spring and the support bracket.

**3**. The tilt steering apparatus according to claim **1**, wherein

the bias spring is made of a single wire and further comprises a pair of coil-spring sections;

the pressure section is formed by bending a middle section of the wire;

the pair of coil-spring sections is formed by winding portions near both end of the wire into a spiral shape, and so as to be separated from each other in the width direction;

the pair of locking-arm sections are formed from both end sections of the wire and in a state so as to extend rearwardly from end sections on opposite side of the pair of coil-spring sections; and

the bracket-side locking sections are provided on side surfaces in the width direction of the pair of support-plate sections.

**4**. The tilt steering apparatus according to claim **3**, wherein the pair of coil-spring sections are located further in front of the pair of support-plate sections and do not overlap the pair of support-plate sections in the forward-backward direction, and are located in positions that are aligned with the pair of locking-arm sections in the width direction.

**5**. The tilt steering apparatus according to claim **3**, wherein the pair of coil-spring sections and the pair of locking-arm sections are located further outward in the width direction than the pair of support-plate sections, and the bracket-side locking sections are provided on outside surfaces in the width direction of the pair of support-plate sections.

**6**. The tilt steering apparatus according to claim **1**, further comprising a guiding member supported by the portion fixed to the vehicle body, and guiding the support bracket in the forward direction while preventing the support bracket from dropping.

**7**. The tilt steering apparatus according to claim **6**, wherein spring-side guiding sections that are vertically in parallel or nearly in parallel with respect to a direction that the guiding member guides the support bracket are provided in portions of the pair of locking-arm sections that come in sliding contact with the bracket-side locking sections during a secondary collision.

**8**. The tilt steering apparatus according to claim **1**, wherein a coating layer made of a low-friction material is formed on the spring-side locking sections.

**9**. The tilt steering apparatus according to claim **1**, wherein grease is applied to engaging portions between the spring-side locking sections and the bracket-side locking sections.

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